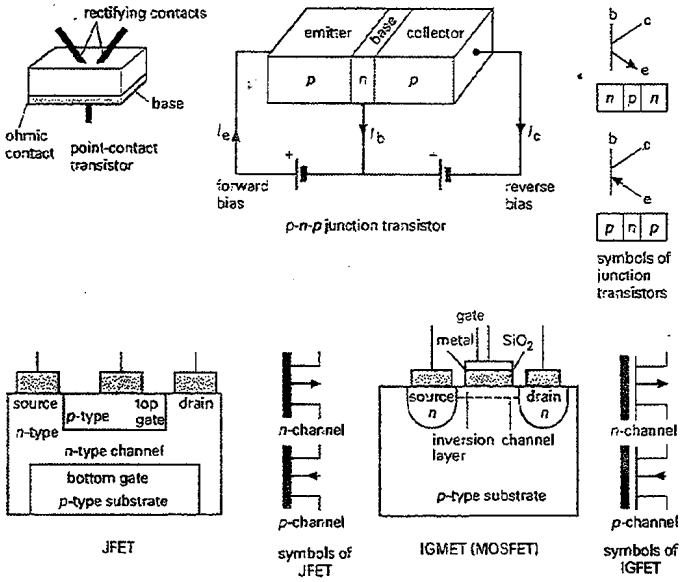
type of connection. If the emitter, base, and collector currents are I_e, I_b, and I_c, respectively, then $I_e = I_b + I_c$ and the current gain is I_c/I_b.

Field-effect transistors are of two kinds, the **junction FET (JFET** or JUGFET) and the **insulated-gate FET (IGFET**; also known as a **MOSFET**, i.e. metal-oxide-semiconductor FET). Both are unipolar devices and in both the current flows through a narrow **channel** between two electrodes (the **gate**) from one region, called the **source**, to another, called the **drain**. The modulating signal is applied to the gate. In the JFET, the channel consists of a semiconductor material of relatively low conductivity sandwiched between two regions of high conductivity of the opposite polarity. When the junctions between these regions are reverse-biased, *depletion layers form, which narrow the channel. At high bias the depletion layers meet and pinch-off the channel completely. Thus the voltage applied to the two gates controls the thickness of the channel and thus its conductivity. JFETs are made with both *n*-type and *p*-type channels.

In the IGFET, a wafer of semiconductor material has two highly doped regions of opposite polarity diffused into it, to form the source and drain regions. An insulating layer of silicon dioxide is formed on the surface between these regions and a metal conductor is evaporated on to the top of this layer to form the gate. When a positive voltage is applied to the gate, electrons move along the surface of the *p*-type substrate below the gate, producing a thin surface of *n*-type material, which forms the channel between the source and drain. This surface layer is called an inversion layer, as it has



Transistors.

opposite conductivity to that of the substrate. The number of induced electrons is directly proportional to the gate voltage, thus the conductivity of the channel increases with gate voltage. IGFETs are also made with both *p*-type and *n*-type channels. Because MOS devices cannot be formed on gallium arsenide (there are no stable native oxides of GaAs), metal semiconductor FETs (MESFET) devices are used. This makes use of Schottky barrier (*see* SCHOTTKY EFFECT) as the gate electrode rather than a semiconductor junction.

transition point (transition temperature) 1. The temperature at which one crystalline form of a substance changes to another form. 2. The temperature at which a substance changes phase. 3. The temperature at which a substance becomes superconducting (*see* SUPERCONDUCTIVITY). 4. The temperature at which some other change, such as a change of magnetic properties (*see also* CURIE POINT), takes place.

translation Motion of a body in which all the points in the body follow parallel paths.

translucent Permitting the passage of radiation but not without some scattering or diffusion. For example, frosted glass allows light to pass through it but an object cannot be seen clearly through it because the light rays are scattered by it. *Compare* TRANSPARENT.

transmission coefficient *See* TRANSMITTANCE.

transmission electron microscope *See* ELECTRON MICROSCOPE.

transmittance (transmission coefficient) The ratio of the energy of some form of radiation transmitted through a surface to the energy falling on it. The reciprocal of the transmittance is the opacity.

transmitter 1. The equipment used to generate and broadcast radio-frequency electromagnetic waves for communication purposes. In **transmitted-carrier transmission** it consists of a carrier-wave generator, a device for modulating the carrier wave in accordance with the information to be broadcast, amplifiers, and an aerial system. In **suppressed-carrier transmission**, the carrier component of the carrier wave is not transmitted; one *sideband (**single-sideband transmission**) or both sidebands (**double-sideband transmission**) are transmitted and a local oscillator in the receiver regenerates the carrier frequency and mixes it with the received signal to detect the modulating wave. 2. The part of a telephone system that converts sound into electrical signals.

transparent Permitting the passage of radiation without significant deviation or absorption. *Compare* TRANSLUCENT. A substance may be transparent to radiation of one wavelength but not to radiation of another wavelength. For example, some forms of glass are transparent to light but not to ultraviolet radiation, while other forms of glass may be transparent to all visible radiation except red light. *See also* RADIOTRANSPARENT.

transponder A radio transmitter–receiver that automatically transmits

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